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# THE NATURAL REGIONS OF THE FRENCH ALPS

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The Alpine region is one of the parts of France of which the geographical study is furthest advanced. Completion of the geological map on the scale of 1:80,000, which event coincided with the foundation of the Institut de Géographie Alpine at the University of Grenoble, afforded the base for the prosecution of a wide range of geographical studies. Much has already been accomplished,<sup>1</sup> and thus it is now possible to present the major geographical features of the French Alps, an extensive region lying between the Lake of Geneva and the Côte d'Azur, a length of 300 kilometers, and the plains of the Rhone and the Italian frontier, a breadth of 150 kilometers. Here, however, in place of discussing the general features of this portion of the Alpine chain we shall endeavor to give some idea of the varied geographical aspects within the region itself.

## The Fundamental Distinction between North and South

The outstanding feature of the regional classification of the French Alps is the contrast presented by the northern and southern portions of the chain. Insistence is laid upon this distinction, for too often one still meets the old division into Alps of Savoy, Dauphiné, and Provence, based on purely historical distinctions long since vanished.

## THE CLIMATIC BOUNDARY LINE

The capital distinction between north and south rests in the climatic characteristics of the two sections, the one exposed to oceanic influences, the other falling within the Mediterranean régime. The Northern Alps, allowance being made for the effects of altitude, enjoys a climate essentially similar to that of the adjacent regions to the west and north—the plain of the Saône, the Central Plateau, the Jura. The temperature is rather low in winter, the summer is warm in spite of its humidity; rains are regularly distributed and abundant, with maxima in the summer and autumn. It may be described as the “maize” type of climate, and in fact cultivation of this cereal along with the mulberry is common in all the valleys of the Northern Alps where the altitude does not exceed 500 meters. The distinctive feature of the climate is the abundant precipitation, both rain and snow, in virtue of the relief and exposure. On the western side

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<sup>1</sup> Published for the most part in the *Recueil des Travaux de l'Institut de Géographie Alpine* (1913–1919) and its successor the *Revue de Géographie Alpine de Grenoble* (1920–).

of the massif of Chartreuse the annual precipitation amounts to between 3 and 4 meters; 9 to 10 meters of snow falls annually at Tour in the valley of Chamonix (altitude 1,400 meters).

On the contrary the southern Alps present—and in a degree little affected by altitude—all the climatic features of the Mediterranean region, in particular the characteristic drought. Temperature is higher; evaporation is more active. The northern winds, of which the mistral is typical, bring no precipitation but on the contrary are avid absorbers of moisture. Rains are rare and correspondingly violent. There are two distinct dry seasons, that of winter and more markedly that of summer, the latter lasting six months. Snows also are scant. On the other hand, the autumn rains fall in tempestuous showers that score the land and swell the torrents with startling suddenness.

### STRUCTURAL DIFFERENCES

To this climatic contrast must be added the structural differences between the two parts of the chain. In the south the trend of the relief is complicated by the effects of two directions of folding, the one Pyrenean, the other Alpine. In the north the arrangement of folds is simple and regular. As is well known, besides simple folding and faulting a large part of the Alpine structure as a whole has been accomplished by horizontal displacement, especially in the central and eastern Alps. Overthrusting is far less important in the French Alps,<sup>2</sup> but even here there is a significant distinction between north and south in this regard. Although the masses of overthrust material (*charriage*) become more abundant as one proceeds to the northeast, in the northern section of the French Alps west of the central massifs they occur only in the little region of Chablais. In the south they occupy an extensive area in the upper Durance basin.

Furthermore, there is dissimilarity between north and south in the nature of the rocks. The south exhibits to a far greater degree than the north a complex of hard and soft rocks.

### EFFECTS OF CLIMATIC AND STRUCTURAL DIFFERENCES

These differences of climate and structure are reflected in all other geographical phenomena. While the relief of the northern section is simple, harmonious, and already in a well-advanced stage, that of the south is irregular and disordered. The highest summits of the southern section fall far short of those of the north, yet the mean elevation is not greatly inferior and penetration is far less easy. Glaciers are naturally less well-developed; the extent is only about one-tenth that of the northern section, and the streams are characterized by irregularity and paucity of discharge

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<sup>2</sup> See Raoul Blanchard: *La structure des Alpes, Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 3, 1915, pp. 163–227. Grenoble.

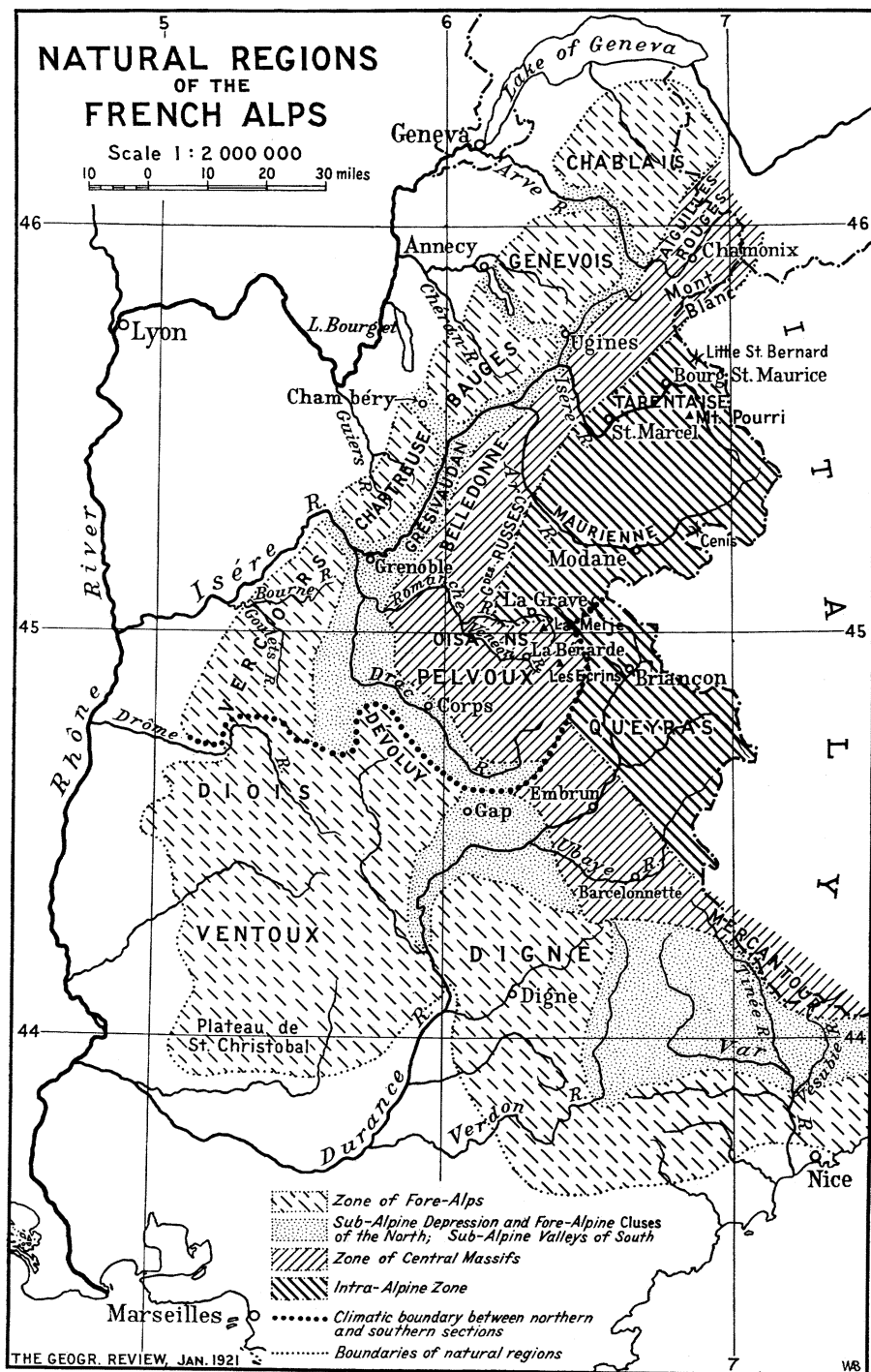


FIG. 1

where those of the north have an abundant and steady flow admirably adapted to industrial purposes.

Under the influence of copious and regular rains the vegetation of the Northern Alps is profuse and fresh. Below the 2,000-meter line forest clothes the slopes, tending to occupy all spaces undisputed by man. Above, to the limit of vegetation at the 2,500-meter line, extend the alpine meadows. In the south the struggle for life is harder. The disseminated vegetation has a meager aspect. In the characteristic forms of *garrigue* and *maquis* are signs of adaptation to drought. On the slopes grass frequently alternates with bare rock.

Human life reflects these conditions. The north is a region of flourishing agriculture based especially on cattle raising. This is the cow country. The drier south is the great sheep domain. In the south irrigation is necessary: insufficiency of water limits cultivation on the characteristically ravined slopes. The length and difficulty of routes across the chaotic mountains restricts traffic, which on the contrary circulates freely along the ample valleys of the north. The same circumstances in combination with the great hydro-electric resources favor industry in the north as against the south. The sum total of influences is reflected in the population densities—19 people per square kilometer in the south, 55 per square kilometer (including the large towns) in the north.<sup>3</sup>

The dividing line between north and south is very clear. It is the remarkable climatic boundary that runs from the Drôme to the Durance by the passes and crests forming the southern boundary of the Isère basin.

### The Northern Alps

Simplicity of structure and relief and the resultant well-developed hydrographic system permit the distinction of the northern Alps into four groups of natural regions parallel to the arc of the chain—the Fore-Alps, the Sub-Alpine Depression, the Central Massifs, and the Intra-Alpine Zone.

#### THE NORTHERN FORE-ALPS

In this region are included the outlying massifs that owe their origin to folding in place in front of the central massifs, exception being made of Chablais where the folds of local origin are buried under masses that have been overthrust from the southeast. The distinctive features of the Northern Fore-Alps are the more clearly revealed towards the west where the massifs overlook the exterior plains and towards the east where they tower still more boldly over the Sub-Alpine Depression. The regular folds of the well-known Jura type, formed in alternate limestones and marls, have been modeled by erosion into lines of white cliffs and longitudinal valleys. The crest lines show none of the typical Alpine forms—no needles,

<sup>3</sup> See J. Robert: La densité de population des Alpes françaises d'après le dénombrement de 1911, *Rev. de Géogr. Alpine*, Vol. 8, 1920, pp. 5-124; noted in the *Geogr. Rev.*, Vol. 10, 1920, p. 345.

no isolated summits—but appear as veritable fortress walls, bastions, high platforms terminated by rude precipices, across which the streams have cut their way by deep gorges, the famous *cluses* of Chéran, the two Guiers, the Bourne, and the Goulets.

Although not greatly elevated (the summits rarely surpass 2,000 meters), these westward-lying heights get the full benefit of exposure to the humid westerly winds and receive the heavy rains and snows to which they owe their wealth of vegetation. This is indeed the country of beautiful meadows and splendid forests (beech and fir), the domain of grass and tree. There



FIG. 2—In the Northern Fore-Alps. The limestone cliffs of Mont Pennay in the Bauges massif.

is little land under cultivation, and even that is steadily diminishing before the meadows. Cattle raising has become almost the exclusive interest of the population, exception being made of the exploitation of the forests.

But the interiors of these rich mountain lands are not easy of access. Despite the marvelous defiles of the *cluses* few railroads approach them. Industrial activity is confined to the periphery, and the population of the interior remains sparse, declining from the north to the south as the means of communication become poorer. The average density of the region is 27 per square kilometer, ranging from 39 in Chablais to 13 in Vercors.

The continuity of the Fore-Alps is broken by great valleys which cross it. Some, such as the Arve and the Isère, are occupied by streams draining to the Rhone. Others, as the *cluses* of Annecy and Chambéry, which preserve traces of former glacial erosion in the still lake-filled depressions

of Bourget and Annecy, are today streamless. Broad and deep, these valleys serve as mountain gateways. Commanding entrance and exit here are the important Alpine towns, Annecy, Chambéry, Grenoble. Ease of communications, industrial development, richness and variety of agri-



FIG. 3—Gorges in the Chartreuse massif, Northern Fore-Alps.

cultural resources distinguish the great *cluses* from the mountains of the Fore-Alps in which they are cut. They may indeed be considered as prolongations of the Sub-Alpine Depression.

#### THE SUB-ALPINE DEPRESSION

Separating the Fore-Alps from the Central Massifs is a zone of much lower altitude. This Sub-Alpine Depression is a monoclinical trench eroded

by riverine and glacial action in the band of soft schists, lying west of the crystalline massifs. It is constituted by a series of valleys of capture by which all the streams of the Northern Alps save the Arve have been brought into the trunk system of the Isère. At Grenoble, where the Isère crosses the Fore-Alps, the depression is very deep (altitude 200 meters). Width and height however vary greatly: in places the floor of the depression attains an elevation of 1,000 meters.

The Sub-Alpine Depression is a varied region. It includes true plains, broad and low as that of Grésivaudan, plateaus, and elevated basins. But, whatever the altitude attained, it is always enclosed by sheltering mountains much more elevated. Everywhere it offers man a fertile soil, the product of the disintegration of the soft rocks enriched by river alluvium and glacial deposition. The agriculture here practiced is of the type of the extra-Alpine plains, but under these exceptional conditions of soil fertility and shelter it offers possibilities of greater diversity and successful prosecution. The vine perhaps claims first place, followed by other fruits. On the alluvial soils cereals yield abundantly, and tobacco and beets flourish. Industry also finds conditions favorable. There is a plentiful labor supply which has, for instance, permitted the development of the famous glove manufactory of Grenoble. Local raw materials, to which may be added the fuel resources (anthracite) of the near-by Central Massifs, have led to the establishment of paper and pasteboard mills and the manufacture of lime and cement. The most notable feature of industry, however, is the use of hydro-electric power. The "white coal" industry began here in 1868; the technique of transmission was mastered in 1884; and today the great factories of the Sub-Alpine Depression, including that of Ugines which employs 3,000 hands, utilize 230,000 horse power.<sup>4</sup>

The depression is the vital artery of the French Alps. All the major routes of communication run for shorter or longer parts of their courses along the depression, which is strung from end to end with a succession of big villages, towns, and little market centers. The density of population averages 54 per square kilometer and in Grésivaudan, the most densely populated part of the French Alps, rises to 196.

### THE CENTRAL MASSIFS

There is a profound contrast between the broad trough described above and the barrier of high massifs which dominate it to the east, mighty mountains including the highest summits of the chain, Mont Blanc (4,810 meters) and Les Ecrins (4,103 meters). These massifs represent ancient Hercynian masses buried under more recent sediments and uplifted by the mountain-building movements of Tertiary time into a broken arc. Here the arrangement is in two parallel lines, the one (exterior) extending

<sup>4</sup> For details see R. Blanchard: L'industrie de la houille blanche dans les Alpes françaises, *Ann. de Géogr.*, Vol. 26, 1917, pp. 15-41.



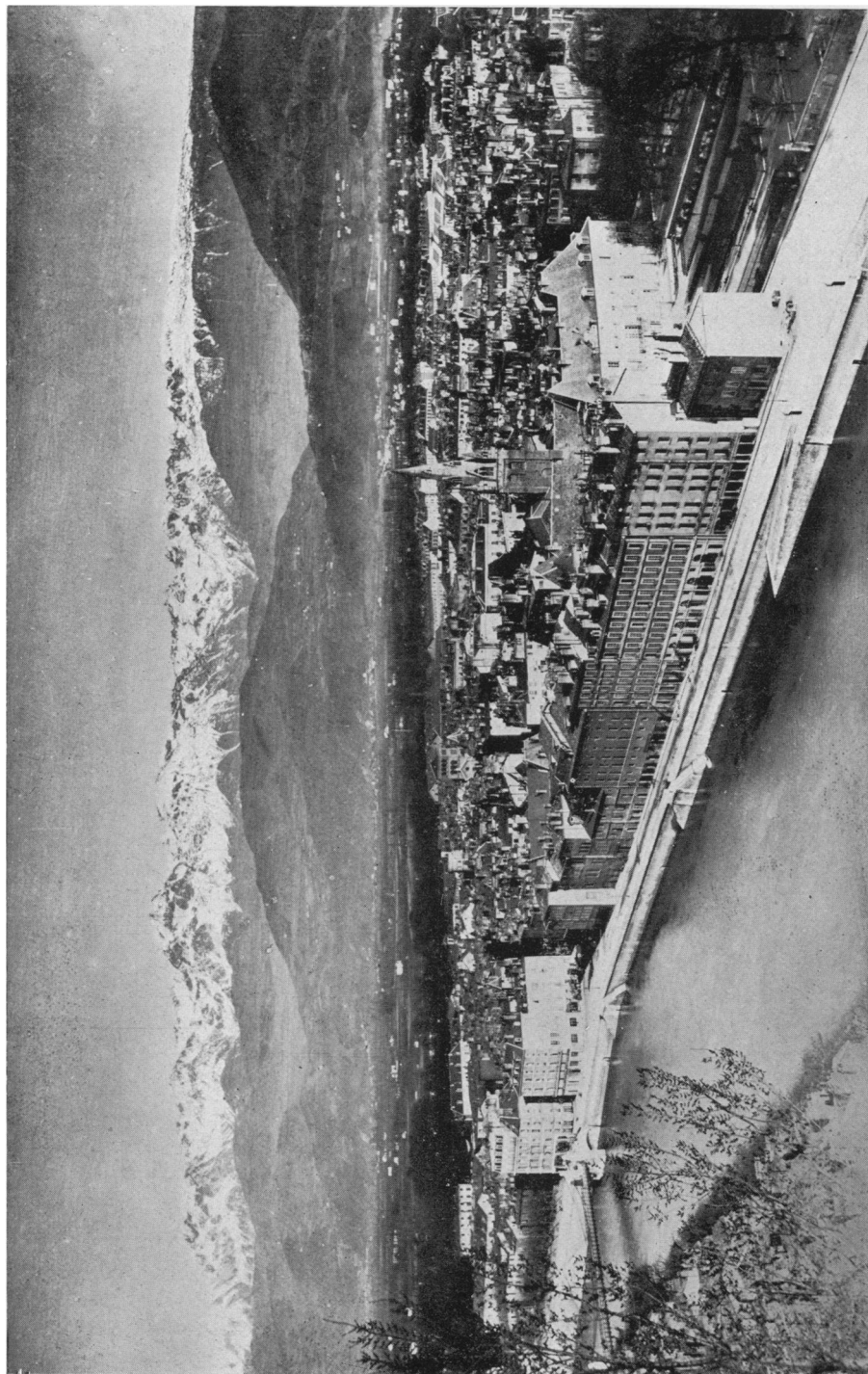


FIG. 4—In the Sub-Alpine Depression, plain of Grésivaudan (Isère valley). Grenoble and the chain of Belledonne (Central Massifs).

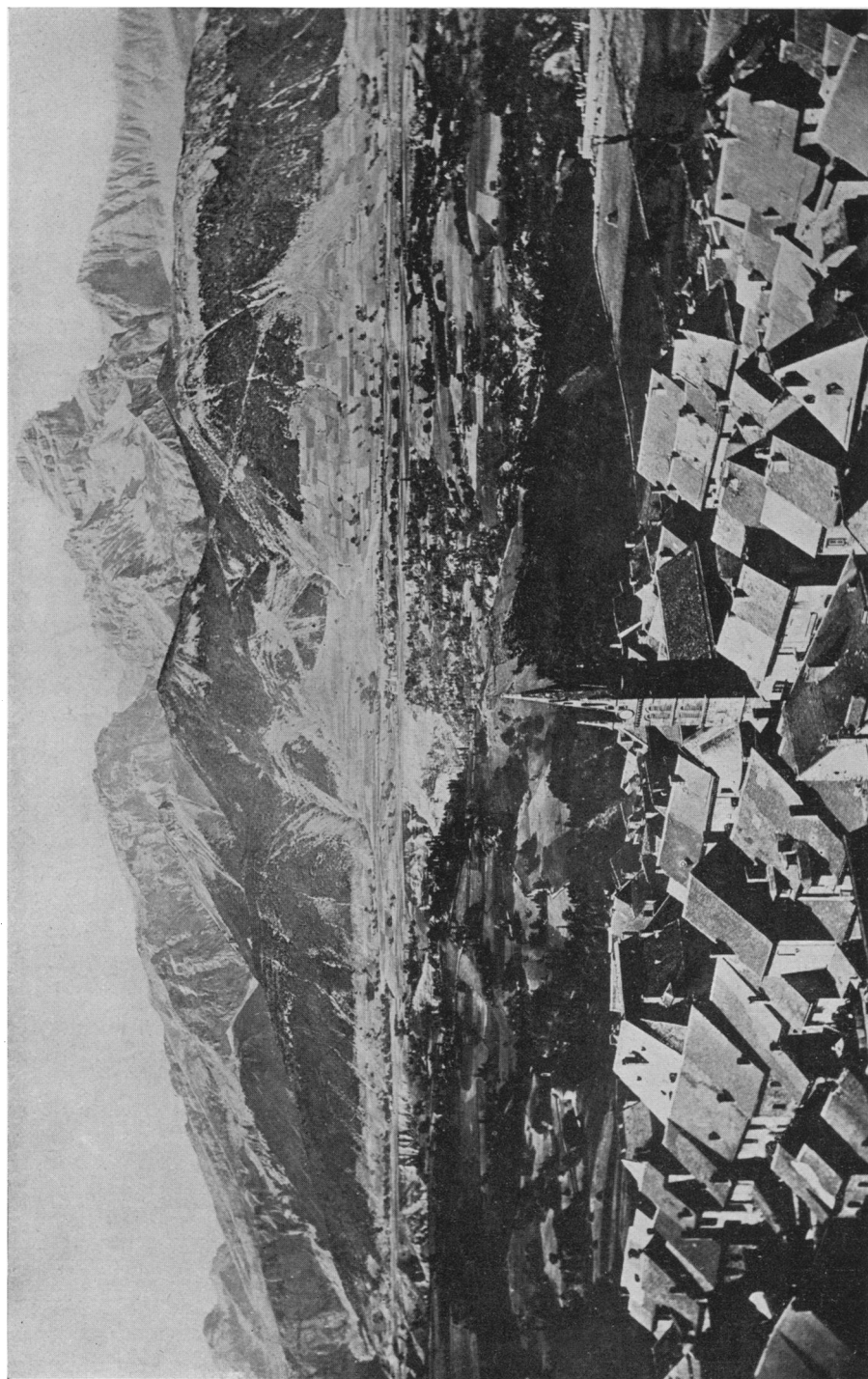


FIG. 5.—In the Sub-Alpine Depression. Valley of the Drac at Corps. In the background L'Obiou, a summit of the Fore-Alps (massif of Dévoluy).

from Aiguilles-Rouges to Belledonne, the other (to the east) from Mont Blanc to Grandes-Rousses, the two meeting in the great crystalline mass of Pelvoux. The effect of pressure against these resistant cores has been to lift them to a great elevation, and they still maintain a great comparative height because of the effective resistance to weathering offered by the hard rock. Here are the usual forms seen in lofty mountains exposed to the active forces of erosion, subaerial and glacial,—a mass of serrated peaks, needles, and teeth, rising above the cirques and the troughlike valleys. Here one finds over half the glaciers of the French Alps (about 260 square kilometers) and among them the great glaciers of Mont Blanc, the Boissons, the Mer de Glace, descending to a level of nearly 1,100 meters and bringing the exotic splendor of their blue *séracs* into the midst of the verdure of forest and meadow.

This lofty zone, of which large areas are covered permanently or seasonally with ice and snow, is a barrier to man. It is of course a region of predilection to the alpinist, and in the recesses of the proud massifs are situated some of the chief tourist centers of the Alps, such as Chamonix and La Bérarde. But otherwise its resources are few. They are limited to such agricultural possibilities as are offered by the synclinal valleys pinched between the crystalline masses, the valley of Chamonix, the plain of Oisans, or to the exploitation of the forests and the pastures in the less elevated zone below the massif of Mont Blanc. The hydro-electric power from the streams is used only in the Sub-Alpine Depression or in the Intra-Alpine Zone. These massifs then are primarily a zone of isolation. Fortunately, however, the barrier is crossed by three passageways, the gorges cut by the Upper Isère, the Arc, and the Romanche, which though narrow afford practicable communication between the Sub-Alpine Depression and the Intra-Alpine Zone.

#### THE INTRA-ALPINE ZONE

Behind the central massifs are piled the great overthrust sheets so characteristic a feature of the Swiss Alps, formidable thicknesses of sediments from the depths of the Alpine geosyncline, gneisses and lustrous schists (phyllites), and towards the west sediments of more varied character and an origin less deep, sandstones, schists, limestones. Naturally the relief modeled upon these sheets is greatly varied in form and altitude. There are deep-sunk basins and steep-walled valleys, massive mountains and peaks most marvelously chiseled. In Tarentaise the floor of the Isère valley is only 800 meters above sea level at Bourg St. Maurice near the frontier, and the graceful pyramid of Mont Pourri overlooking it attains an altitude of 3,788 meters. In Oisans the Meije rises 2,500 meters above the basin of La Grave.

The contrasts between other geographical features is correspondingly accentuated. The closely sheltered basins are less well-watered. Not one receives as much as a meter of precipitation a year. The forest is less

extensive than in the western region and of a different facies: the larch, a tree thriving in drier and sunnier areas, replacing the spruce and fir. The alpine meadows occupy a more elevated zone than in the Central Massifs, and cultivation likewise climbs higher, here and there attaining a height of 2,000 meters. The lower slopes of the deep, sheltered valleys are limited to the more delicate cultivations: the vine is found at elevations of 1,000 meters. Thus the inhabitant of the zone finds highly varied agricultural resources—vineyards and orchards, fields and forests, alpine



FIG. 6—Glacial trough of Vénéon, massif of Pelvoux.

pastures—at his disposition, and he makes use of them all by becoming a veritable nomad. In the winter even as well as in the fine season he is on the move passing from stage to stage: when he is no longer needed in the vineyards he occupies an alpine *châlet* in the zone of high pastures; when cold drives him thence he returns by successive steps to the valley.

As in the Sub-Alpine Depression industry is correspondingly developed. The Intra-Alpine Zone utilizes 570,000 horse power, about half the hydro-electric force furnished by the French Alps. The greater part is employed in electro-chemical and electro-metallurgical industries. Similarly, ease of communication is another favorable factor. The zone is the highway of Franco-Italian traffic which makes use of the passes of the Little St. Bernard and Mont Cenis and of the Paris-Turin railway.

Of old these various favoring circumstances led to a fairly considerable density of population and promoted the growth of little independent

civilizations that were in effect mountain republics (Maurienne, Tarentaise, Oisans) comparable to the forest cantons of Switzerland. Today the population density of lower Tarentaise is 44 per square kilometer, of lower Maurienne, 50; and the civilization of this high mountain region remains the most distinctive of the four natural regions of the French Alps.

### The Southern Alps

Broader, and of more complex structure, the southern section of the French Alps presents a much more confused relief than that of the north, and the natural regions are correspondingly less clearly defined. A continuation of the four regions of the north can indeed be recognized, but their physiognomy is modified and the relations between them are different. While the Fore-Alps here occupies a relatively enormous area, the Intra-Alpine Zone is reduced, tapering out to the verge of disappearance. Between the Central Massifs are intercalated mountain ranges of dissimilar character; the Sub-Alpine Depression gives place to another regional type—the Sub-Alpine valley.

### THE SOUTHERN FORE-ALPS

South of Vercors the folded Fore-Alps become increasingly broad at the expense of the Central Massifs which bend sharply towards the southeast. Instead of the simple folding of the northern Fore-Alps, we have here sequences of short folds pertaining to two systems of different age and direction. Furthermore, the constituent rocks are less homogeneous than those of the north and consequently have suffered more under diastrophism and subsequent weathering. Where the black marls and yellow clays predominate and the massive white limestones are rare, erosion has powerfully modified the original relief, excavating a series of little basins from which the waters drain by picturesque defiles.

The Southern Fore-Alps are much drier, a feature specially marked in the valleys. At the bottoms of the basins are irrigated fields, watered meadows, and vineyards; on the suitably exposed slopes the more delicate fruit trees. Under shelter the olive is cultivated in a zone extending right across the region. The upper slopes, however, support only a meager brushwood including characteristic aromatic plants and affording pasturage for sheep and goats. These massifs are the poorest and least populated part of the Alps. The average density is 16, falling to 12 in the massif of Digne.

Furthermore, in spite of their moderate altitude these massifs constitute a true wall isolating the southern Alps from the exterior. No ample valleys give access across them as is the case in the north. The Verdon, for instance, issues from the Fore-Alps by a canyon so narrow that it has been followed by but a few explorers and by these only at the risk of life. The



FIG. 7



FIG. 8

FIG. 7—Intra-Alpine Zone of the North. The station of Modane (Maurienne) close to the Italian frontier.  
 FIG. 8—In the Intra-Alpine Zone of the North, the *verrou* of St. Marcel (Tarentaise). Hydro-electric establishment in the foreground.

Durance alone describes a valley broad enough to be termed a plain, and it is by this open highway that all communication is effected between Provence and the Alps. With its hydro-electric establishments and its flourishing agriculture the Durance might rather be regarded as the equivalent of the Sub-Alpine Depression of the north.

#### THE SUB-ALPINE VALLEYS OF THE SOUTH

The Sub-Alpine Depression disappears simultaneously with the break in the Central Massifs, that is on the southern border of Pelvoux. In place of that long corridor serving all the passages of the mountain are a series of transverse compartments terminating most frequently in a *cul-de-sac*. Only in the region of Gap, where a domal structure is developed and where the softness of the rocks has facilitated erosion, is there a depression of any continuity; and this peripheral depression is, as it were, a turntable of communications in the southern Alps. But the valleys of the Verdon, the Var, the Tinée, and the Vésubie are separated from one another giving only onto very elevated passes. Few parts of the Alps are more isolated. a striking contrast with the corresponding region of the north.

On the other hand, these valleys are much better watered than the Fore-Alps. On the slopes are fine forests, larch and pine mingled with spruce; the lower slopes above the olive groves are adorned with superb chestnuts. The raising of cattle as well as sheep is carried on. The water courses are well fed, and industry has commenced. The works under way will provide for 150,000 horse power in the near future, destined principally for the Côte d'Azur. The favorable features increase as approach is made to the Mediterranean. The density of population, only 10 per square kilometer along the Verdon, rises to 27 in the valley of the Vésubie.

#### THE CENTRAL MASSIFS

Further contrasts with the Northern Alps appear in the southern continuation of the zone of Central Massifs. The Hercynian masses which constitute these massifs disappear south of Pelvoux to reappear to the southeast in the massif of Mercantour which with its bold peaks, cirques, and little glaciers recalls the great ranges of the north. The hiatus between Pelvoux and Mercantour is filled in by a great mass of Flysch sediments, beds of sandstones and schists inclined towards the west and supporting here and there limestone fragments that give a characteristic contour to these mountain summits. Yet contrariwise to the north these mountains do not constitute a barrier. Across the little-resistant surface the upper Durance and the Ubaye have worn down the Flysch to the underlying very soft black marls and have excavated basins therein, as those of Embrun and Barcelonnette, sites for settlement and passageways permitting access to the Intra-Alpine Zone.



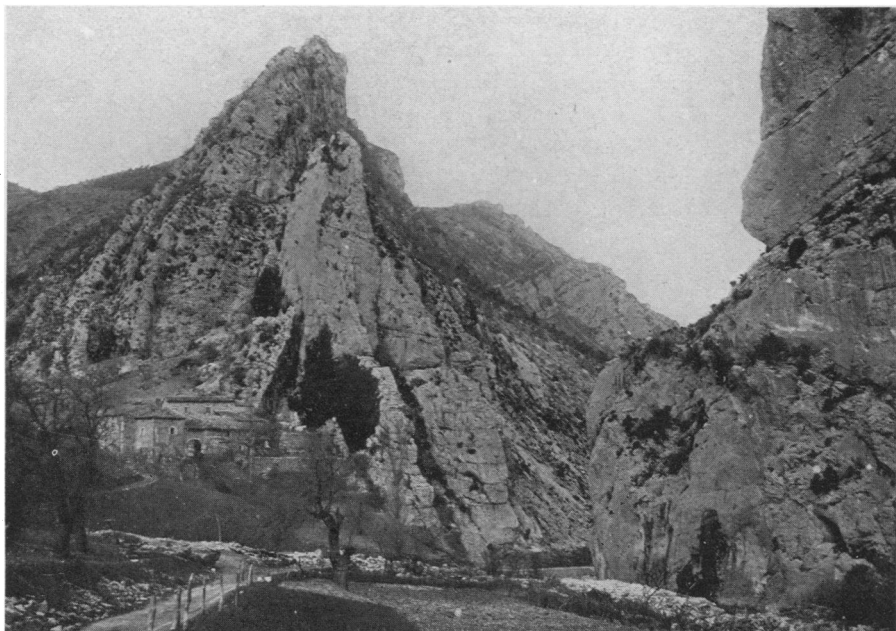


FIG. 9

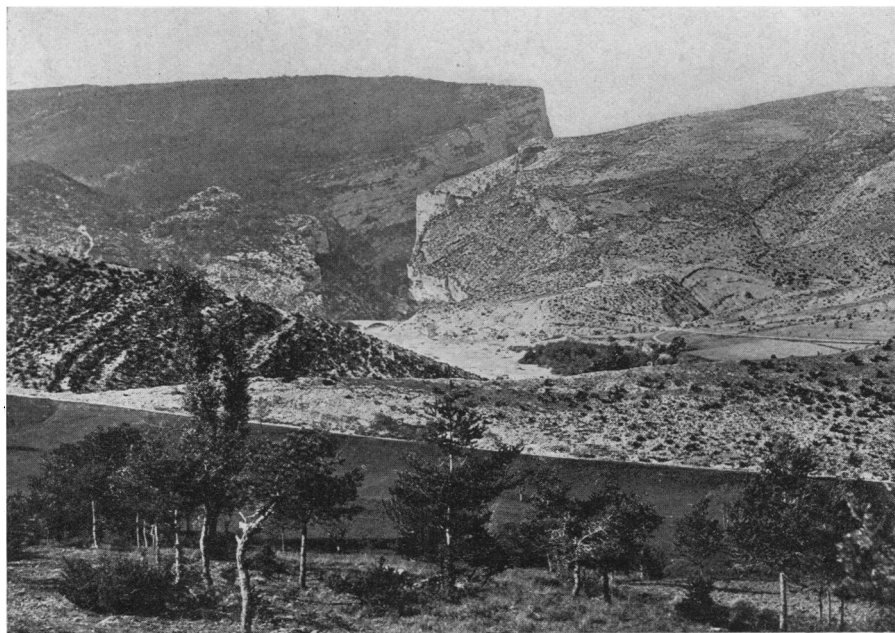


FIG. 10

FIG. 9—In the Southern Fore-Alps. Gorge in Diois.

FIG. 10—House types at Queyras. Intra-Alpine Zone of the South. Altitude 2,000 meters.





**FIG. 11**



**FIG. 12**

**FIG. 11—In the Sub-Alpine Valleys of the South. Entrance to the gorges of the Verdon.**  
**FIG. 12—In the Sub-Alpine Valleys of the South. The lower Tinée.**



FIG. 13



FIG. 14

FIG. 13—In the Central Massifs of the South. A typical basin in the Flysch of Embrunais.

FIG. 14—In the Central Massifs of the South. A basin in the Flysch (soft black marls) of Ubaye.

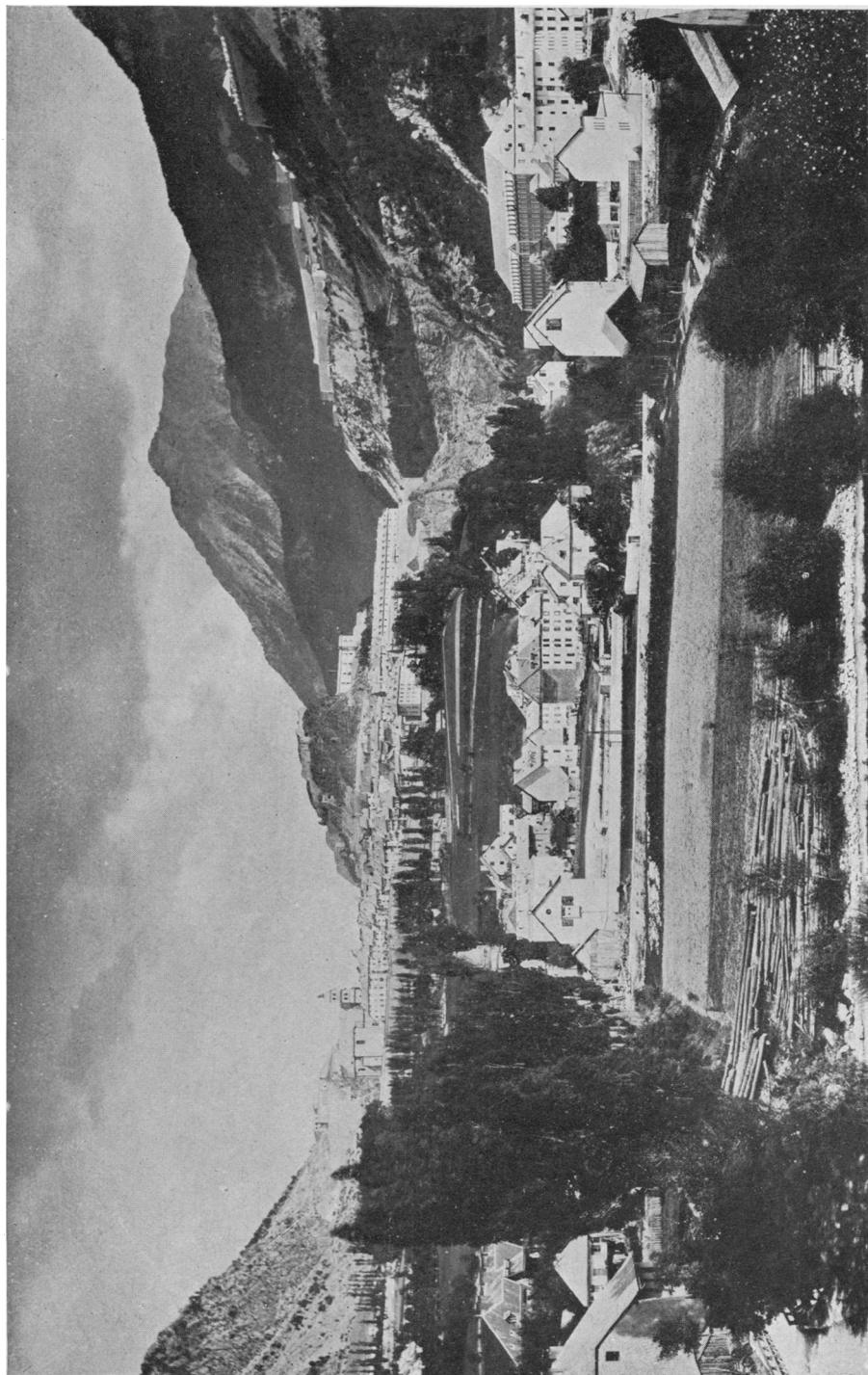


FIG. 15—Briançon, a town of the Intra-Alpine Zone of the South.

## INTRA-ALPINE ZONE

Of the four divisions of the southern Alps the Intra-Alpine Zone is the one most closely resembling the corresponding zone of the north. In the great thickness of overthrust folds it exhibits the same diversity of hard and soft rocks and the same variety of forms—ample basins deep as that of Briançon, longitudinal valleys of notable dimensions, transverse defiles whose floors are interrupted by the *verrous* (barriers of hard rock) characteristic of many glaciated Alpine valleys, high valleys, broad and open with gently sloping sides. Dryness is pronounced because of the distance from the Mediterranean. At Briançon is registered the smallest rainfall in the French Alps, 587 millimeters. Dryness and clearness of the air in this elevated region, so sheltered and so sunny, make it one of the most salubrious spots in Europe.

The altitude is considerable. Although the summit levels rarely surpass 3,000 meters, the mean elevation of the zone is greater than that of the north—a fact indicative of the less advanced stage of evolution of the relief. Here are situated the most elevated towns and villages of the French Alps. Here cultivation is carried on at the greatest elevations, and the upper limit of the forest likewise attains its highest level (2,500 meters). However, these lands are but ill-exploited. Isolation has retarded agricultural progress which remains based on polyculture and the extensive raising of sheep. This is the part of the French Alps where population has had its most rapid decline in consequence of extensive emigration both internal to Marseilles and external to Mexico and South America.

On either side of the climatic line dividing the French Alps into northern and southern sections profound differences are exhibited by the respective regions, always to the disadvantage of the southern section, less open, less penetrable, less “humaine.”